

stimulus and sensation at ten stages between black and white. A comparison of the last two columns will show the extent of agreement between observation and calculation. The numbers given under the head of stimulus are calculated on the basis of the suggested law, the number 27 per cent. of stimulus, as the concomitant of 50 per cent. of sensation, being taken over from observation as a basis for calculation.

Although I venture to hope that the results of this investigation contribute something towards a solution of the problem, still it will be seen that we have as yet by no means reached the stage at which we can claim that a law expressing the quantitative relation of stimulus to sensation is established beyond question. But from the work of many observers we may at least draw the conclusion that there is some well-defined relation, though its law at present eludes the grasp of our generalisation. And this so far lends support to the doctrine of concomitance.

There has been much discussion as to the true meaning of the relation. Is it primarily a relation between physical stimulus and physiological response, or between physiological response and psychological concomitant? In other words, is the law we seek primarily a physiological or a psychological law? We

were only 1.22 inch in diameter, and the length of the arms, from the centre of cup to the spindle, only 1.96 inch. The author describes at length the whirling apparatus used in making the experiments, and which had been previously used in the year 1888, but in an enclosed space, instead of in the free air. He points out that a whirling apparatus is absolutely necessary for testing anemometers, because we have no other means of accurately measuring the speed of the wind to which the instrument is exposed, unless we employ for that purpose some other anemometer, which must itself be first tested. In the author's view, the effect of using the whirler in the open air is to alternately add to and subtract from the artificial wind resulting from the steady motion of the whirler, so that the actual resultant wind affecting the anemometer acquires a *gusty* character which is analogous to the conditions always existing in the free air, and the artificial gusty wind thus secured affords a highly appropriate test-wind for anemometers that are to be used in the open air. The apparatus employed is shown in a plate, which we reproduce.

The arm, on the extreme end of which the anemometer is placed, is 28 feet long, and is made to rotate either by hand-power or by means of the engine used in the kite experiments.

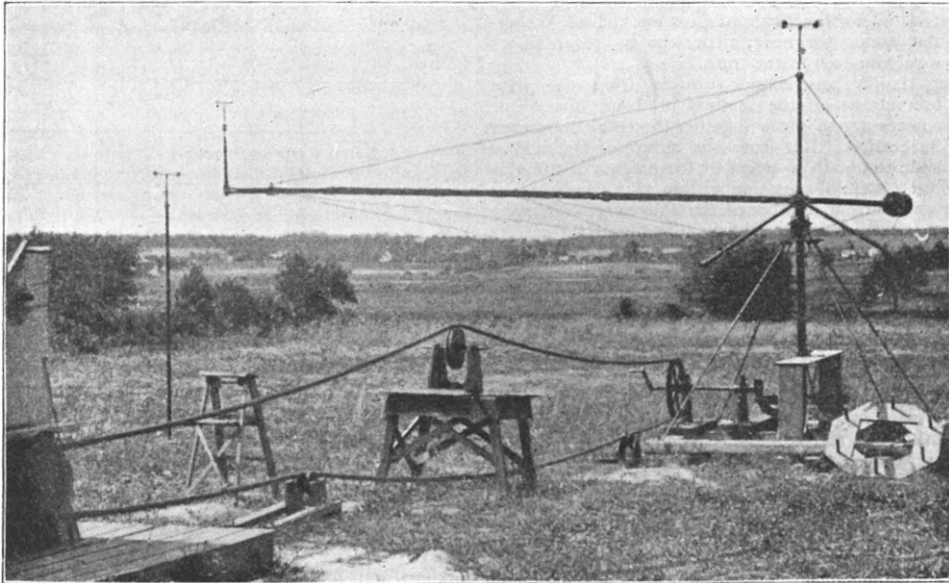


FIG. 1.—Whirling Machine and Driving Belt for Anemometer Tests.

cannot enter upon the discussion here. Attention may, however, be drawn to two facts:—First, that Prof. Pfeffer claims to have shown that the attractive influence of malic acid on the spermatozooids of ferns is approximately in accordance with the Weber-Fechner formula; and secondly, that Dr. Augustus Waller's researches on the excitation of muscle and nerve indicate some such relation, though not exactly this relation, between stimulus and physiological response. In view of these facts it seems not improbable, therefore, that the relation may prove to be primarily physiological. In which case we may infer that sensation is directly proportional to the molecular disturbance in the nerve-centres concerned.

C. LLOYD MORGAN.

ANEMOMETER TESTS.

THE U.S. *Monthly Weather Review* for February contains an important contribution by Prof. C. F. Marvin on anemometer tests. The paper gives the results of a series of experiments to determine the factor of an anemometer specially designed for use with kites at considerable altitudes in the free air. For that purpose the anemometer has necessarily to be very small and light, and in the present case the cups

By hand-power any speed up to thirty-five miles an hour could be obtained, and by the engine the velocity could be raised to nearly sixty miles an hour. A good break-circuit seconds pendulum clock was employed, in conjunction with an astronomical chronograph, to record results, and the series of comparisons appears to have been carried out with much care and completeness.

The experiments included a redetermination of the constants for a "standard aluminium cup anemometer," in which the cups were 4.07 inches in diameter, and the arms 6.65 inches in length. This instrument had been used in the investigations of 1888, and the values now obtained gave a slightly lower rate of speed of the cups in a given wind than had been formerly deduced. But as the differences did not exceed 2 per cent., it is fair to conclude that, upon the whole, the agreement was satisfactory.

The author also points out that another result of the experiments is to confirm a conclusion arrived at in 1888, viz. that an anemometer with large cups, as compared with the length of the arms, runs at a speed bearing a more nearly constant ratio to that of the wind than an anemometer with relatively larger arms. In the case of the small kite anemometer now investigated, the factor is practically constant for velocities from ten to fifty miles an hour, the extreme variation being only about 1.5 per cent.